University of Bahrain

College of Information Technology

Department of Computer Science

Semester 2, 2012-2013

ITCS312/ITCS314 (Formal languages and Automata Theory)

Test-II

Date: May 13, 2013 **Time**: 3:00-4:00

STUDENT NAME	DRAGON
STUDENT ID #	
SECTION	

NOTES:

- WRITE ONLY ONE SOLUTION FOR EACH QUESTION.
- SWITCH OFF YOUR MOBILE PHONES.
- THIS EXAM CONTAINS 4 PAGES INCLUDING THE COVER PAGE.
- ANSWER ALL THE FOLLOWING QUESTIONS
- $\sum = \{a,b\}$ UNLESS STATED OTHERWISE

QUESTION #	MARKS		COMMENTS
1	8	6	
2	12	$10\ 3/4$	
3	10	$9\ 3/4$	
TOTAL	30	$26\ 1/2$	

Question One (True/ False) (8 marks)

1. $a^n b^{2n}$ is a non-regular language (True).
2. ∧ will be in Pref(Q in R) if there is no common words in Q and R . (False)
3. The quotient of two regular languages is unique. (False)
4. If number of states in FA is 4 and Σ has 3 alphabets, then the number of the possible accepted words between n and less than 2n in length is 243. (False)
5. A CFG is called a RG if the language productions of the form (False)
   Nonterminal → working string
   Nonterminal → word
6. If R1 = R2, then the FA representing the intersection has always accepted words.(True)
7. The total tree can be sometimes finite even if we have infinite language. (False)
8. The language is ambiguous if it can be represented by more than one parse tree (True)

6

Question Two (12 marks)

1. Give the CFG for the language $a^n b^{2n}$ where n >=0. (2 marks)

$S \rightarrow aSbb \mid \lambda$ 2

2. Give CFG for $a^x b^y a^z$ where z=x-y & x,y,z >= 0 (2 marks)

$S \rightarrow \lambda \mid aXa$

$X \rightarrow aXa \mid aaRba \mid \lambda$

$R \rightarrow \lambda$

how you get aaabba for example

3. Given the following CFG, give another CFG to show that this language is regular. (3 marks)

$aa(a+b)(a+b)^* bb$

S -> aaXbb
X -> aX | bX | a | b

$S \rightarrow aaR_1$

$R_1 \rightarrow aR_2 \mid bR_2$

$R_2 \rightarrow aR_2 \mid bR_2 \mid bb$

3

10 3/4

4. Give the CFG for (a+bb) abba (ab + aa) (3 marks)

$S \rightarrow X\,abba\,Y$

$X \rightarrow a \mid bb$

$Y \rightarrow ab \mid aa$ ✓ 2 3/4

5. Given the following CFG, use leftmost derivation to derive **aaabb** if derivable. (2 marks)

S -> XY
X -> XX | a
Y -> YY | b

2

$S \Rightarrow XY \Rightarrow XXY \Rightarrow aXY \Rightarrow aXXY \Rightarrow aaXY \Rightarrow$

$\Rightarrow aaaY \Rightarrow aaaYY \Rightarrow aaabY \Rightarrow aaabb$ ✓

Question 3 (10 marks)

1. Convert the following CFG to CNF (3 marks)

a 3/4

S → Ab | bb | ABa
A → ∧ | BR | a
B → b | RMA | aa
R → b | ∧ | S
M → aba | ∧

A, R, M are Nullables

stage 1: remove ∧ productions

$S \rightarrow Ab \mid bb \mid ABa \mid b \mid Ba \mid Aa$
$A \rightarrow BR \mid a \mid B \mid R$
$B \rightarrow b \mid RMA \mid aa \mid MA \mid RM \mid RA \mid R \mid M \mid A$
$R \rightarrow b$
$M \rightarrow aba$

stage 2:

$S \rightarrow AB_1 \mid B_1B_1 \mid ABA_1 \mid b \mid BA_1$
$A \rightarrow BR \mid a \mid b \mid RMA \mid A_1A_1 \mid MA \mid RM \mid RA \mid b \mid A_1B_1A_1 \mid BR \mid a$
$B \rightarrow b \mid RMA \mid A_1A_1 \mid MA \mid RM \mid RA \mid b \mid A_1B_1A_1 \mid BR \mid a$
$R \rightarrow b$
$M \rightarrow A_1B_1A_1$

2 3/4

stage 3:

$S \rightarrow AB_1 \mid B_1B_1 \mid AR_1 \mid b \mid BA_1$
$A \rightarrow BR \mid a \mid b \mid RR_2 \mid A_1A_1 \mid MA \mid RM \mid RA \mid A_1R_3 \mid BR \mid a$
$B \rightarrow b \mid RR_2 \mid A_1A_1 \mid MA \mid RM \mid RA \mid A_1R_3 \mid BR \mid a$
$R \rightarrow b$
$M \rightarrow A_1R_3$
$R_1 \rightarrow BA_1$
$R_2 \rightarrow MA$
$R_3 \rightarrow B_1A_1$
$A_1 \rightarrow a$
$B_1 \rightarrow b$

2. Using Pumping lemma, verify whether the language $a^n b^m$ is regular or not, where n >= m & n,m >= 0 . (3 marks)

assume the language is regular and Has FA with r states.

∴ $a^r b^r$ should be in the language (if n=m)

$a^r = uvw$ such that $v \neq \epsilon$

∴ for $k \geq 0$, $uv^k wb^r$ is in the language

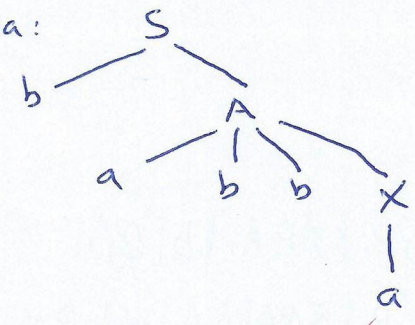
but for $k=0$, uwb^r is also in the languge, but uw contain less a's than a^r, ∴ the langnge is not regular.

3

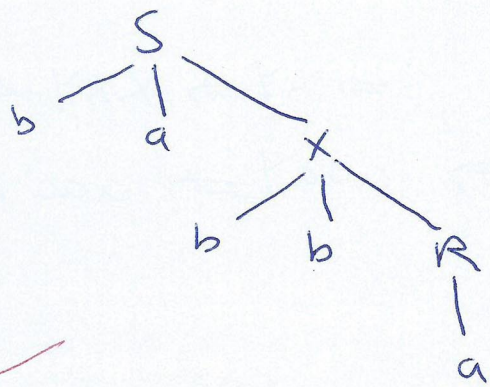
3. Check whether the following grammar ambiguous or unambiguous. (2 marks)

S -> baX | bA |aaM
M -> abS |bb
X -> bbR | a
A -> abbX | ∧
R -> a | b

for babba:



2



2

∴ there are two parse trees for the same string.

∴ the grammar is ambiguous.

4. Given the following CFG, give another CFG without unit production (2 marks)

S -> AA
A -> B | BB
B -> abB | b | bb

Solution:

$S \longrightarrow AA$

$A \longrightarrow abB \mid b \mid bb \mid BB$

$B \longrightarrow abB \mid b \mid bb$

2

$A \longrightarrow B$

$A \Rightarrow B \Rightarrow abB$

$A \Rightarrow B \Rightarrow b$

$A \Rightarrow B \Rightarrow bb$